Preface

The Service Manual introduces the ZF 4WG200(4WG158、6WG200 also applied)transmission removal and assembling process and offers the transmission service process technology and standard requirements, which can help the service personnel understand the transmission removal and assembling methods more profoundly as well as lay a solid technical foundation for the service personnel to correctly judge the malfunction and do troubleshooting.

The Service Manual mainly includes following content:

Chapter I. Introduction
The chapter mainly introduces the transmission service precautions as well as symbol meanings and common thread tightening torque value in the text.

Chapter II. Transmission System
The chapter mainly introduces the mechanical principles of different gears of the transmission as well as the transmission operation and maintenance.

Chapter III. Transmission Removal
The chapter introduces the correct parts removal steps as well as precautions during removal.

Chapter IV. Transmission Assembling
The chapter introduces the correct parts assembling steps as well as precautions during assembling.

Chapter V. Malfunction Diagnosis and Troubleshooting
The chapter introduces the malfunction diagnosis and troubleshooting of the transmission system and ZF transmission.

Attention
Due to product improvements, relevant parts in the Service Manual will be subject to change without further notice. For the newest data and information, please consult with or get them from Shandong Lingong Construction Machinery Co., Ltd.
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1 Introduction

1.1 Safety Precautions

⚠️ **Important Safety Precautions**

The maintenance and repair is very important for a safe vehicle operation. The Manual mainly describes the correct removal and assembling technology of the transmission assembly.

To avoid personal injuries, ⚠️ will be made as the safety mark in the Manual. The precautions with shall be paid high attention to. In case of potential dangers, it is recommended to consider the own safety first of all, and then consider taking necessary safety measures.

⚠️ **Safety Tips**

During assembling and removal, wrong operation method will lead to parts damages, service life shortening, service performance deterioration, and other unsafe factors. Accordingly, when assembling and removing the parts, it is recommended to carefully read the Manual.

1. All parameters, figures and relevant content in the Manual are applicable for the standard equipped product. For derivative product, please consult with us or refer to relevant materials.

2. In the repair workshop, the places special for assembling and removal operation and storing removed parts shall be prepared, and the corresponding tools and parts shall be placed in a proper site. In addition, the working area shall be kept clean, which shall be free from oil dirt and pollutants. Smoking is only allowed in the specified place; smoking is not allowed during operation, and corresponding fire extinguishers shall be prepared.

3. The welding operation can only be conducted by the trained personnel with welding experience. During welding, welding gloves, retainer, goggles, work cap and other work clothes applicable for welding operation.

4. Before removing the transmission-torque converter assembly, it is necessary to clean pollutants on the surface of the transmission-torque converter assembly, so as to avoid polluting the parts during removal.

5. During operation, it is necessary to wear safety boots and safety helmet. It is not allowed to wear unqualified work clothes; it is necessary to fasten buttons of the work clothes. When knocking the parts with the copper rod, it is necessary to wear goggles.

6. The gasoline, kerosene and water-based oil stain cleaning agent can be used to clean the removed parts.

7. When applying the traveling crane or other hoisting equipment, check relevant spreader for damages first of all, and such hoisting equipment with sufficient hoisting capacity shall be used. During hoisting, the appointed hoisting position shall be used for slow hoisting, so as to avoid parts collision. It is not allowed to work in the area under the hoisted parts.
Attention

As the torque converter has no axial positioning, it is necessary to prevent its slipping in case of removal and assembling of the transmission, as shown in Figure 1-1.

Figure 1-1

8. In case of simultaneous operation with two or more persons, they shall reach an agreement in the operation procedures before operation, so as to avoid accidents due to incompatible pace.

9. It is necessary to properly keep all tools and be familiar with their application methods.

10. In case of alignment of two holes, it is forbidden to insert hands and fingers. For parts to be directly assembled by hand, it is necessary to pay attention that the gripping position is free from squeezing danger.

11. It is necessary to test the removed parts; the parts whose application performance is affected shall be replaced with a new one.

12. After assembling, the parts shall be free from interference.

13. When assembling the oil seal and seal ring through the keyway, screw hole and step, it is necessary to apply relevant protection measures to avoid damages.

14. When assembling the parts, the applied tools shall match with the thread fastener, so as to avoid damages.

15. When screwing down the connector body and screw plug, it is not allowed to use pneumatic wrench and other similar tightening tools. It is necessary to screw them down by hand and then with the torque wrench with corresponding capacity, so as to reach the corresponding torque value.

16. When draining out fluid in the transmission, it is necessary to slowly screw off the oil drain plug, so as to avoid fluid spraying.
1.2 Instructions of Marks and Symbols

To ensure that the Manual can play a role, it is necessary to use marks specified in Table 1-1 for aspects of the important safety and quality requirements.

<table>
<thead>
<tr>
<th>Mark</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Safety]</td>
<td>Special attention shall be given to the safety in case of operation.</td>
</tr>
<tr>
<td>![Attention]</td>
<td>Special attention shall be given to the safety in case of operation as there is pressure inside.</td>
</tr>
<tr>
<td>![Attention]</td>
<td>Special attention shall be given to the technical requirements in case of operation to ensure that the operation is qualified.</td>
</tr>
<tr>
<td>![Weight]</td>
<td>Part or device weight or removal and assembling method.</td>
</tr>
<tr>
<td>![Weight]</td>
<td>Attention shall be given to selection of the spreader and its operation posture.</td>
</tr>
<tr>
<td>![Tightening torque]</td>
<td>Special attention shall be given to the tightening torque of the component in case of assembling.</td>
</tr>
<tr>
<td>![Coating]</td>
<td>The place which needs adhesive and lubricating grease coating.</td>
</tr>
<tr>
<td>![Oil and water]</td>
<td>Fill the engine oil, water and fuel with certain capacity.</td>
</tr>
<tr>
<td>![Draining]</td>
<td>The place needing oil or water draining and draining capacity.</td>
</tr>
</tbody>
</table>

1.3 Common Bolt Tightening Torque Table

<table>
<thead>
<tr>
<th>Bolt strength grade</th>
<th>Yield strength N/mm²</th>
<th>Nominal diameter of bolt mm</th>
<th>Tightening torque Nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8</td>
<td>640</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9~12</td>
<td>22~30</td>
</tr>
<tr>
<td>10.9</td>
<td>900</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13~16</td>
<td>30~36</td>
</tr>
<tr>
<td>12.9</td>
<td>1080</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16~21</td>
<td>38~51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bolt strength grade</th>
<th>Yield strength N/mm²</th>
<th>Nominal diameter of bolt mm</th>
<th>Tightening torque Nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8</td>
<td>640</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>193~257</td>
<td>264~354</td>
</tr>
<tr>
<td>10.9</td>
<td>900</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>280~330</td>
<td>380~450</td>
</tr>
<tr>
<td>12.9</td>
<td>1080</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>326~434</td>
<td>448~597</td>
</tr>
<tr>
<td>Bolt strength grade</td>
<td>Yield strength N/mm²</td>
<td>Nominal diameter of bolt mm</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tightening torque Nm</td>
<td></td>
</tr>
<tr>
<td>8.8</td>
<td>640</td>
<td>952~1269</td>
<td>1293~1723</td>
</tr>
<tr>
<td>10.9</td>
<td>900</td>
<td>1400~1650</td>
<td>1700~2000</td>
</tr>
<tr>
<td>12.9</td>
<td>1080</td>
<td>1606~2142</td>
<td>2181~2908</td>
</tr>
</tbody>
</table>
2 Transmission System

2.1 Transmission Introduction

2.1.1 General Overview of the Transmission

The ZF power gearshift transmission is composed of the hydraulic torque converter and rear-mounted countershaft transmission with multi-sheet friction clutch. The SDLG 938L、948L wheel loader adopts the 4WG158 gearbox assembly, the SDLG 958L、959、968 wheel loader adopts the 4WG200 gearbox assembly which can realize speed switching between 4 forward gears and 3 reverse gears. The SDLG G9190 grader adopts the 6WG200 gearbox assembly which can realize speed switching between 6 forward gears and 3 reverse gears.

![Diagram of Transmission System](image)

**Figure 2-1**

1. Connecting socket
2. Torque converter shell
3. Transmission control valve
4. Transmission pressure measuring port
5. Torque converter oil temperature measuring port
6. Transmission oil outlet
7. Oil suction pipe
8. Transmission housing
9. Nameplate

![Diagram of Transmission System](image)

**Figure 2-2**

10. Lifting ring screw
11. Oil filter
12. Auxiliary PTO
13. Main PTO
14. KV
15. KR
16. K2
17. K1
18. K3
19. K4
20. Rotation speed sensor
21. Parking brake
1. Auxiliary PTO
2. Variable speed pump
3. KVK1 clutch assembly
4. Intermediate shaft component
5. KRK2 clutch assembly
6. K3K4 clutch assembly
7. Output shaft assembly
2.1.2 Basic Parameters of the Transmission-torque Converter Assembly

Table 2-1

<table>
<thead>
<tr>
<th>Item</th>
<th>4WG158</th>
<th>4WG200</th>
<th>6WG200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission gear</td>
<td>Four forward gears and three reverse gears</td>
<td>Six forward gears and three reverse gears</td>
<td></td>
</tr>
<tr>
<td>Torque converter inlet oil pressure (bar)</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque converter outlet oil pressure (bar)</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission working pressure (bar)</td>
<td>16&amp;18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gearbox oil draining capacity (L)</td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.1.3 Mechanical Principles of the Gears of the Transmission (4WG158/200)

1. First forward gear

\[ Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_1 \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{\text{output}} \]

The solenoid valves M2, M3, M4 act and the transmission pressure oil flows into KVK1 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear \( Z_0 \rightarrow \) forward gear input gear \( Z_V \rightarrow \) forward gear clutch \( KV \rightarrow \) KV1 ring gear assembly \( Z_{V1} \rightarrow \) first gear clutch K1 \( \rightarrow \) gear \( Z_1 \) of the first gear \( \rightarrow \) second gear combination gear \( Z_2 \rightarrow \) gear \( Z_3 \) of the third gear \( \rightarrow \) output shaft gear \( Z_{\text{output}} \rightarrow \) output shaft, as shown in Figure 2-5.
2. Second forward gear

The solenoid valves M3 and M4 act and the transmission pressure oil flows into KVK2 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear $Z_0$ → forward gear input gear $Z_V$ → forward gear clutch KV → KV1 ring gear assembly $Z_{V1}$ → KR2 ring gear assembly $Z_{R2}$ → second gear clutch K2 → second gear combination gear $Z_2$ → gear $Z_3$ of the third gear → output shaft gear $Z_{\text{output}}$ → output shaft, as shown in Figure 2-6

$Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_{R2} \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{\text{output}}$

Figure 2-5

Figure 2-6
3. Third forward gear

The solenoid valve M3 acts and the transmission pressure oil flows into KVK3 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear \(Z_0\) → forward gear input gear \(Z_V\) → forward gear clutch KV → KV1 ring gear assembly \(Z_{V1}\) → KV2 ring gear assembly \(Z_{R2}\) → K34 ring gear assembly \(Z_{34}\) → third gear clutch K3 → gear \(Z_3\) of the third gear → output shaft gear \(Z_{\text{output}}\) → output shaft, as shown in Figure 2-7.

\[
Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_{R2} \rightarrow Z_{34} \rightarrow Z_3 \rightarrow Z_{\text{output}}
\]
4. Fourth forward gear

The solenoid valve M5 acts and the transmission pressure oil flows into K3K4 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear $Z_0 \rightarrow$ forward gear input gear $Z_V \rightarrow$ intermediate gear $Z_{\text{intermediate}} \rightarrow$ gear $Z_4$ of the fourth gear $\rightarrow$ fourth gear clutch $K_4 \rightarrow$ K34 ring gear assembly $Z_{34} \rightarrow$ third gear clutch $K_3 \rightarrow$ gear $Z_3$ of the third gear $\rightarrow$ output shaft gear $Z_{\text{output}} \rightarrow$ output shaft, as shown in Figure 2-8

$Z_0 \rightarrow Z_V \rightarrow Z_{\text{intermediate}} \rightarrow Z_4 \rightarrow Z_{34} \rightarrow Z_3 \rightarrow Z_{\text{output}}$

5. First reverse gear

The solenoid valves M1, M2, M4 act and the transmission pressure oil flows into KRK1 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear $Z_0 \rightarrow$ reverse gear input gear $Z_R \rightarrow$ reverse gear clutch $KR \rightarrow$ KR2 ring gear assembly $Z_{R2} \rightarrow$ KV1 ring gear assembly $Z_{V1} \rightarrow$ first gear clutch $K_1 \rightarrow$ gear $Z_1$ of the first gear $\rightarrow$ second gear combination gear $Z_2 \rightarrow$ gear $Z_3$ of the third gear $\rightarrow$ output shaft gear $Z_{\text{output}} \rightarrow$ output shaft, as shown in Figure 2-9

$Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_{V1} \rightarrow Z_1 \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{\text{output}}$

![Figure 2-9](image)

6. Second reverse gear

The solenoid valves M1 and M4 act and the transmission pressure oil flows into KRK2 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear $Z_0 \rightarrow$ reverse gear input gear $Z_R \rightarrow$ reverse gear clutch $KR \rightarrow$ KR2 ring gear assembly $Z_{R2} \rightarrow$ second gear clutch $Z_2 \rightarrow$ second gear combination gear $Z_2 \rightarrow$ gear $Z_3$ of the third gear $\rightarrow$ output shaft gear $Z_{\text{output}} \rightarrow$ output shaft, as shown in Figure 2-10

$Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_{\text{output}}$
7. Third reverse gear

The solenoid valve M1 acts and the transmission pressure oil flows into KRK3 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear \( Z_0 \rightarrow \) reverse gear input gear \( Z_R \rightarrow \) reverse gear clutch KR \( \rightarrow \) KR2 ring gear assembly \( Z_{R2} \rightarrow \) K34 ring gear assembly \( Z_{34} \rightarrow \) third gear clutch K3 \( \rightarrow \) gear \( Z_3 \) of the third gear \( \rightarrow \) output shaft gear \( Z_{\text{output}} \rightarrow \) output shaft, as shown in Figure 2-11

\[ Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_3 \rightarrow Z_{\text{output}} \]
The working conditions of the corresponding solenoid valves and clutches are shown in Table 2-2:

<table>
<thead>
<tr>
<th>Gear</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>M5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Clutch K1</td>
<td>K2</td>
<td>K3</td>
<td>K3</td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The pressure measuring ports of all gears are shown in Figure 2-12:

Standard pressure of all measuring ports: The pressure of the first gear and the second gear is 16bar; the pressure of the third gear and the fourth gear is 18bar, and the relief valve pressure is 10bar. The KV (forward)/KR (reverse) clutch pressure will change along with gear changes, and the transmission pressure is same as that of the corresponding gear.

2.1.4 Introduction to KD Key Functions (4WG158/200)

(1) KD (Kick-Down) function, namely the low gear shift function.

There is one button at the end of DW-2 gearshift handle, which is the KD key, and it can be used to decrease the vehicle speed to the first forward gear from the second forward gear.
(2) Brake power cutoff function of the first gear and the second gear.

In the electric control system, two pressure cutoff switches (one is the service brake pressure switch and one is the emergency/parking brake pressure switch) can be connected. When the driver steps down the foot brake pedal for brake; due to interaction between the brake pressure and the service brake pressure switch, the pressure switch will turn on the power circuit and the computer (namely the electric control box) circuit (equivalent to one electric signal of the computer), and then the computer will command the transmission control valve to act and cut off the pressure oil passage of the transmission clutch, namely the transmission power from the engine. In such case, all power of the engine will be transmitted to the working pump of the loader. Accordingly, when the first and second gears work, the working hydraulic system of the loader will have more sufficient power to perform excavation operation, thus improving the working efficiency of the working device.

In addition, when pressing down the emergency/parking brake button, the emergency/parking brake pressure switch will also act; the pressure switch will turn on the power circuit and the computer circuit, and then the computer will command the transmission control valve to act (namely the transmission power from the engine will be cut off in case of emergency brake), thus improving the brake effect.

(3) Neutral gear locking function and neutral gear start interlock function for vehicle safety improvement.

The gear control handle DW—2 is designed and installed at the lower left part of the steering wheel; if rotating the handle, the speed can be changed to the first, second, third and fourth gears, as shown in Figure 2-13. If pushing the control handle forwards, the vehicle will be driven forwards; if pushing the control handle backwards, the vehicle will be driven backwards; if the control handle stays at the neutral gear, the vehicle will keep still.

![Figure 2-13 Gear Control Handle of 4WG200 Transmission](image)

The neutral gear safety lock is used to avoid vehicle movement due to misoperation. When turning the safety lock to position “D”, the vehicle gear will be engaged for traveling; when turning the safety lock to position “N”, the vehicle will be locked at the neutral gear.

If engaging the neutral gear and rotating the locking button of the neutral gear safety lock of the gearshift handle to the locking position (at position “N”), the vehicle will be locked at the neutral gear to avoid gear engagement due to misoperation.
The engine can be started if engaging the neutral gear. When engaging the neutral gear and opening the electric lock, the gearshift handle will send an electric signal to the start interlock relay, and then the start circuit will be connected; or else, the engine can’t be started.

(4) Working process of KD key of ZF transmission

With KD function (namely the forced low gear shift function), the loader working efficiency can be greatly enhanced. During operation, the loader will be started at the second gear and then driven at the third gear; when approaching to sand and stone material piles, the second gear will be engaged. In case of material excavation, if pressing down KD key (without rotating the gearshift handle), the vehicle speed will be automatically reduced to the first gear. When the bucket is full, pull the gearshift handle backwards to the reverse gear, and the vehicle can be automatically turned to the second reverse gear from the first forward gear.

When being driven backwards to a proper position, push the gearshift handle forwards to the forward gear and change speed according to following process: 2R → 2F → 3F → 2F. Before being driven to the dump truck and discharging materials onto the dump truck, change speed according to following process: 2F → 2R → 3R → 2R, and then the loader will return to the start point. KD function will be released after rotating the gearshift handle.

In case of material excavation, it is unnecessary to rotate the loader handle to select the speed gear, just perform operation according to steps shown in Figure 2-14:

2.1.5 Operation and Maintenance of ZF Power Gearshift Transmission

1. Application precautions

(1) When checking the transmission oil level, the engine shall run at idle speed (about 1000 rpm) and the oil temperature shall be kept at the normal working temperature;
(2) When the oil temperature is 40 ℃, the oil level shall be between the middle and lower scale lines of the oil dipstick.

When the oil temperature is 80 ℃, the oil level shall be between the middle and upper scale lines of the oil dipstick.

(3) Strictly follow the maintenance requirements and periodically replace the transmission oil and the filter.

(4) Before starting the vehicle engine, ensure that the control handle is at the neutral gear.

(5) Before every traveling, loosen the parking brake (release the brake).

(6) In case of engaging or separating the engine and the transmission and lifting the transmission, try to avoid torque converter detachment.

(7) During parking, the gearshift handle shall be turned to the neutral gear.

(8) The normal working oil temperature shall be kept between 80—110 ℃; when bearing the heavy load, it can rise to 120 ℃ in a short time. It is necessary to pay special attention to the control oil pressure of the transmission. If transmission is discovered to be abnormal during use, it is necessary to stop the vehicle for check.

(9) When the vehicle has malfunction and needs electric welding maintenance, it is necessary to remove the cable plug on EST—computer controller (cut off the circuit leading to the computer controller); or else, the computer controller may be burnt due to impact current during electric welding.

2. Operation

(1) Preparations and maintenance before traveling

Before transmission operation, it is recommended to properly fill the lubricating oil with specified specification. In case of initial oil filling of the transmission, it is necessary to consider that the oil radiator, filter and connecting pipe shall be filled with oil. Accordingly, the lubricating oil in the first filling shall be much more than that for the subsequent normal maintenance. As the torque converter oil on the vehicle will flow to the transmission via the oil radiator and oil pipe under a stationary state, the oil level shall be correctly controlled under the thermal equilibrium temperature in case of neutral gear engagement upon parking, idle engine running and normal transmission operation.

The oil level can be tested when the control handle is turned to the neutral gear. When checking the oil level, it is necessary to insert the oil dipstick to the lower limit of the oil pipe. When cleaning the main oil circuit filter, pay attention that no dirt and sediment can enter into the oil circuit. In addition, it is necessary to place a cover plate to prevent the parking brake from oil immersion.

When installing the filter, it shall not be screwed down too tightly.

(2) Traveling and gear shift

In case of engine start, it is necessary to confirm that the gearshift handle is turned to the neutral gear. For the sake of safety, before engine start, the parking brake shall be in a brake
state, so as to ensure that the vehicle will not be started due to engine start. After engine start, release the parking brake; properly select the traveling direction and gear; slowly throttle up the vehicle for start. In case of vehicle traveling, the torque converter will replace the function of the main clutch. When the road conditions are good, the vehicle can be driven with a high gear.

If the vehicle is stopped but the engine still runs and the transmission gear is engaged, the engine will not be stopped. For some traction force may be produced when the engine passes the torque converter at idle speed, the vehicle may crawl on a straight pavement. The rational method is to turn the parking brake to a brake state upon each parking.

To park the vehicle for a long time, the control handle shall be turned to the neutral gear. During traveling, it is recommended to loosen the parking brake of the vehicle. From experience, we draw a conclusion that the operator is hard to immediately find out that: When the torque converter speed changes, due to large output torque ratio of the torque converter, the vehicle can overcome the brake torque and forcedly travel even under the normal operation conditions. The consequence is that the torque converter oil temperature will rise and the brake will become too hot.

Due to impact of the torque converter, when shifting to low speed gear from the high speed gear, the engine rotation speed will increase, specially the gear shift with skipping a grade. Accordingly, if conditions permit, when shifting to low speed gear from the high speed gear, firstly step down the foot brake; perform deceleration slowly and then shift gear. When the vehicle travels at high speed and the traveling direction is changed, it is necessary to reduce the engine rotation speed.

(3) Suspension and parking

As there is no rigid connection between the engine and the torque converter output shaft, when the vehicle is parked on the slope (upslope or downslope) while the driver wants to leave the vehicle, to avoid vehicle sliding, we recommend to apply the parking brake and place stop blocks under wheels.

(4) Dragging

The max. dragging speed is 10km/h and the max. dragging distance is 10km.

When the distance is longer, the vehicle with malfunction shall be placed on other vehicle for transportation.

(5) Oil temperature

The transmission oil temperature shall be monitored with the temperature sensor. The max. oil temperature of the torque converter outlet shall not be higher than 120°C; the normal control component and the transmission with sufficient traveling mileage will not have higher temperature. If the oil temperature is higher than 120°C, the vehicle shall be stopped for oil leakage check. And, the transmission shall be turned to the neutral gear and the engine shall run at 1200~1500rpm. In such case, the oil temperature will quickly reduce to the normal value (within about 2~3 min.). If the oil temperature doesn’t fall down, it means that the system has malfunction, and operation can be continued after troubleshooting.

Normal gear shift oil pressure range: 1.6&1.8MPa (16~18bar). To monitor the control pressure, it is necessary to install a pressure gauge or pressure monitoring meter. In case of engaging
some gear and applying the clutch but the pressure drops to the min. pressure lower than the specified pressure (the pressure will quickly drop temporarily in case of gear shift), it is necessary to do troubleshooting. If the control pressure is too low, the clutch will be damaged, for the clutch without sufficient contact pressure will make the friction lining continuously slip and become too hot.

3. Maintenance

(1) Oil level check

— Park the vehicle in a flat place
— Turn the transmission gearshift handle to the neutral gear (“N”) and the parking brake to the brake position.
— Idly run the engine with about 1000rpm
— Counterclockwise loosen the oil dipstick and then take it out and wipe it off
— Insert the oil dipstick in the oil level pipe and screw it down; keep it for about 3s after reaching the target position, and then take it out (twice measurement at the least)
— At 40°C, the oil level shall be between the lower scale “cold” and the middle scale
— At 80°C, the oil level shall be between the upper scale “hot” and the middle scale

The cold vehicle oil level check is only to ensure that the transmission and the torque converter have sufficient circulating flow. The final standard to determine the oil level is to meet the hot vehicle oil level requirements.

★ Attention

If the oil level is lower than the min. scale, it is necessary to fill the recommended lubricating oil till the oil level rises to the correct scale range of the corresponding temperature (see Figure 2-15).

★ Attention

According to different types of transmissions, the oil dipstick and filler pipe will have different lengths and shapes. In addition, the filler pipe and transmission have two connection methods: One is to connect the filler pipe at the side of the torque converter and another is to connect the filler pipe at the brake side.

The following Figure shows the connection condition between the filler pipe (and the oil dipstick) and the transmission:
— Torque converter side
— Insert the oil dipstick and clockwise screw it down.
1. Oil filler with oil dipstick

2. Oil drain plug (M38×1.5)

Figure 2-15

(2) Oil replacement

When the vehicle reaches the first 100 working hours, the first oil replacement shall be done. After that, the oil replacement shall be done once every 1000 working hours or every year.

During oil replacement, it is recommended to stop the vehicle in a flat place; keep the transmission at the working temperature; take out the oil drain plug and seal ring, and drain out residual oil.

——Start the engine and run it at idle speed

——Turn the transmission control handle to the neutral gear (“N”)

——Fill oil till reaching the upper scale in the “cold” oil area

——Turn the parking brake to the safe position

——Select all gears once

——Check the oil level again

——If necessary, fill oil again

——At 40℃, the oil level shall be between the lower scale “cold” and the middle scale

——At 80℃, the oil level shall be between the upper scale “hot” and the middle scale

⭐ Attention

When you drain the oil out, the oil in the torque converter cooler should be drained out too.
## Oil Replacement Period Table: Table 2-3

<table>
<thead>
<tr>
<th>Part name</th>
<th>First oil replacement</th>
<th>Normal oil replacement</th>
<th>Oil product standard</th>
<th>Oil level check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>Upon 100 working hours, the filter shall also be replaced</td>
<td>Upon every 1000 working hours, not longer than one year, and the filter shall also be replaced</td>
<td>SAE15W40 Mobil Delvac Super 1300 or TITAN universal engine oil HD15W—40 (produced by Shanghai Desi Oil Product Company)</td>
<td>Before daily use</td>
</tr>
</tbody>
</table>

## Other optional oil product: Table 2-4

<table>
<thead>
<tr>
<th>Domestic oil grade</th>
<th>Kinematic viscosity (100℃) mm²/s</th>
<th>Similar foreign oil product grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>6# hydraulic transmission oil Q/SHO18.44.03-1994</td>
<td>5–7</td>
<td>CALTEX Torque fluid 175; RPM Torque fluid NO.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ESSO Torque Fluid 47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHELL Rotella 10 w</td>
</tr>
</tbody>
</table>

### (3) Oil filter replacement

In case of each oil replacement, ZF coarse filter shall also be replaced. The replacement requirements are as follows:

—— Coat the seal ring with a thin layer of oil

—— Press down the filter till it contacts with the sealing surface of the transmission; after that, screw it down for 1/3 to 1/2 circles by hand

—— Fill oil

—— Start the engine

—— When the engine idly runs (about 1000rpm) and the transmission oil has a working temperature, check the transmission oil level.

—— When the oil temperature is 40℃, it shall be within the “cold” oil level range.

—— When the oil temperature is 80℃, it shall be within the “hot” oil level range.

—— Check if it is screwed down. If necessary, screw it down by hand again.
3 Transmission Removal

3.1 Transmission Assembly Removal

3.1.1 Torque Converter Removal

1. Pull out the intermediate ring and the torque converter from the transmission; completely drain out residual oil in the torque converter and place it aside.

2. Remove the bolt connecting with the shell and the transmission.

Figure 3-1

1 Torque converter
2 Intermediate ring

Figure 3-2

1 Hexagon screw (M10*50)×14
2 Tension pin
3. Adjust the transmission to a proper position; slightly knock the connecting shell periphery with the copper rod, and take down the connecting shell.

★ Attention
Upon knocking, ensure that the force which is applied on the connecting shell periphery is uniform.

3.1.2 Transmission Control Valve Removal

1. Take down 6 hexagon socket head cap bolts from the transmission control valve with the hexagon socket spanner.

★ Attention
Strictly follow the sequence of “From outside to inside and diagonal removal” to remove bolts.

2. Respectively take down 11 hexagon socket head cap bolts from the transmission control valve with the hexagon socket spanner.

★ Attention
It is recommended to place two screws in the removed thread holes at the top, so as to avoid control valve sliding due to removal of the head cap screws.

Strictly follow the sequence of “From outside to inside and diagonal removal” to remove bolts.
3. Take down the transmission control valve, paper pad, cover plate and valve pad.

★ Attention
After removing the transmission control valve, do well in its cleaning and protection.

4. Take down six oil pipes from the oil passage plate in turn, which are K2, K1, K3, K4, KR and KV from top to bottom. In addition, remove the oil passage connector on the clutch shafts and take down six oil pipes.

★ Attention
Do well in oil pipe connector protection, and mark the oil pipe number with the marker. After removing the connectors, do well in their cleaning and protection.

5. Take down 8 hexagon socket head cap bolts between the oil passage plate and the transmission.

★ Attention
Strictly follow the sequence of “From outside to inside and diagonal removal” to remove bolts.
6. Take down 3 hexagon socket head cap bolts between the oil passage plate and the transmission.

★ Attention

It is recommended to place two screws in the removed thread holes at the top, so as to avoid control valve sliding due to removal of the head cap screws.

7. Take down the oil passage plate, packing 1, cover plate and paper pad.

★ Attention

After removing the oil passage plate, do well in its cleaning and protection.

8. The transmission control valve removal is completed.
3.1.3 Oil Filter Removal

1. Rotate the oil filter with the belt spanner for removal.

2. After taking down the O-ring, the removal is completed.
3.1.4 Removal of the Auxiliary PTO Wheel Hub

1. Take down the bolt between the auxiliary PTO wheel hub and the transmission body.

2. After pushing out the wheel hub with the crowbar and taking down the PTO wheel hub and its seal ring, the removal is completed.

3.1.5 Input Device Removal

1. Remove the hexagon bolts between the pump impeller bearing seat and the oil feed flange.
2. Slightly knock the bearing seat with the copper rod for loosening.

3. Take down the bearing seat and the packing.

4. Take down the bolt between the main PTO wheel hub and the transmission body.
5. Pull out the main PTO component with two shackle bolts (M20).

★ Attention
During removal, the transmission shall be placed flatly; the PTO port shall face upwards and the force applied on two shackle bolts shall be uniform.

Figure 3-21
1 Shackle bolt mounting hole
2 Main PTO

6. Hold one about φ30*400mm copper rod by left hand to jack up the variable speed pump end cover, and hold another copper rod by right hand to knock out the oil feed flange and the variable speed pump component and place them aside.

⚠ Attention
The copper rod shall be used to slightly knock the oil feed flange and the variable speed pump component, so as to avoid component slipping.

7. After taking down the input device, the removal is completed.

⚠ Attention
Slowly take down the input device to avoid slipping.
3.1.6 Removal of the Lubricating Oil Pipe Component and Auxiliary PTO

1. Respectively screw off hollow bolts (M18) at both ends of the transmission lubricating oil pipe and then take out the oil pipe.

2. Take down the snap ring from the PTO shaft with the snap ring pliers.

3. Knock out the PTO shaft with the copper rod and take down the PTO driving gear.
4. The auxiliary PTO removal is completed.

3.1.7 KVK1 Clutch Assembly Removal

1. Screw off two hexagon nuts on the KVK1 clutch shaft and pull out the clutch shaft with tooling.

2. Take down the thrust washer and the compensation washer from the KVK1 clutch shaft.

★ Attention
When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.
3. Take out the KVK1 clutch assembly from the transmission body.

⚠️ Attention

When taking out the clutch assembly, place the transmission in a proper position, and the operation shall be slow to avoid slipping.

Figure 3-30
1 KVK1 clutch assembly
2 Transmission body

4. The KVK1 clutch assembly removal is completed.

⭐️ Attention

Mark the KVK1 clutch with the marker for convenient distinguishing.

3.1.8 KRK2 Clutch Assembly Removal

1. Screw off two hexagon nuts from the KRK2 clutch shaft and pull out the clutch shaft with the tooling.

Figure 3-32
1 Hexagon nut (M8)
2 Clutch shaft removal tooling
2. Take down the thrust washer and the compensation washer from the KRK2 clutch shaft.

★ Attention

When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.

Figure 3-33
1 Compensation washer 2 Thrust washer 3 Thrust washer

3. Take out the KRK2 clutch assembly from the transmission body.

★ Attention

When taking out the clutch assembly, place the transmission in a proper position, and the operation shall be slow to avoid slipping.

Figure 3-34
1 KRK2 clutch assembly

4. The KRK2 clutch assembly removal is completed.

★ Attention

Mark the KRK2 clutch with the marker for convenient distinguishing.

Figure 3-35
1 KRK2 clutch assembly
3.1.9 K3K4 Clutch Assembly Removal

1. Remove two hexagon nuts from the K3K4 clutch shaft.

2. Pull out the clutch shaft with the tooling.

3. Take down the thrust washer and the compensation washer from the K3K4 clutch shaft.

★ Attention

When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.
4. Take out the K3K4 clutch assembly from the transmission body.

⚠️ Attention
When taking out the clutch assembly, hold the clutch assembly with the clutch shaft positioning tooling, and the operation shall be slow to avoid slipping.

Figure 3-39
1 K3K4 clutch assembly
2 Clutch shaft positioning tooling (29380017611)

5. The K3K4 clutch assembly removal is completed.
★ Attention
Mark the K3K4 clutch with the marker for convenient distinguishing.

Figure 3-40
1 K3K4 clutch assembly

3.1.10 Removal of the Parking Brake and the Output Device
1. Remove the bolt and washer between the brake wheel hub and the brake flange.
★ Attention
After taking down the wheel hub, connect 2 bolts (M10*25) between the butterfly pressure plate and the brake wheel hub.

Figure 3-41
1 Hexagon head screw (M10*25)×6
2 butterfly pressure plates
3 Nut (M10)×2
2. Take down the brake wheel hub and remove the lock washer.

3. Remove the bolt between the pressure plate and the output flange.

4. Take down the pressure plate, distance washer and O-ring.
5. Remove the brake flange and the fixing plate.

6. Remove the brake drum wheel.

⚠️ **Attention**
When removing the drum wheel, the force shall be slow and sufficient, and protection measures shall be taken to avoid spring detachment.

7. Take out the oil seal from the output device.

⭐ **Attention**
When taking out the oil seal, the force shall be uniform and sufficient to avoid damages. And, the special removal tooling can also be used.
8. Take down the lock washer and remove the bolt between the pressure plate and the output flange.

9. Take down the pressure plate, distance washer and O-ring in turn.

10. Take down the output flange.
11. Take down the oil seal.

**Attention**
When taking out the oil seal, the force shall be uniform and sufficient to avoid damages. And, the special removal tooling can also be used.

12. Remove the front end bearing snap ring and compensation washer of the output shaft with the snap ring pliers.

13. Knock the rear end of the output shaft with the copper rod.
14. Take down the output shaft, bearing and shaft sleeve.

15. Take out the output gear and remove the bolt between the retainer, oil shield and transmission body.

16. Take out the oil shield and the retainer.
17. The removal is completed.

3.1.21 Intermediate Shaft Assembly Removal

1. Remove the sealing washer.

2. Remove the bolt between the intermediate shaft and the transmission body.

Figure 3-57

Figure 3-58
1 Sealing washer

Figure 3-59
1 Head cap screw
3. Take out the intermediate shaft and the O-ring.

4. After taking out the intermediate shaft and the bearing component, the removal is completed.
3.1.22 Removal of the Output Shaft Rotation Speed Sensor

1. Remove the rotation speed sensor from the transmission body and take down the adjustable washer and the seal ring.

3.1.23 Removal of the Seal Cover of the Transmission Body

1. Take down the seal cover from the transmission body.

3.1.24 Removal of the Torque Converter Pressure Regulating Valve

1. Remove the screw plug fixing the valve sleeve component.
2. After taking out the valve sleeve components (valve sleeve, valve stem, pressure spring and gasket) from the torque converter pressure valve hole of the transmission body, the removal is completed.

### 3.2 Transmission Assembly Component Removal

#### 3.2.1 Main PTO Removal

1. Remove the retainer ring fixing the driving gear on the PTO shaft with the snap ring pliers.

2. Remove the snap ring fixing the inner ring of the ball bearing on the PTO shaft.
3. Expand and fix the ball bearing elastic retainer ring with the screwdriver and knock the PTO shaft from another side.

4. Take down the driving gear, PTO shaft and ball bearing.

5. After taking down two retainer rings fixing the needle bearing on the PTO wheel hub and removing two elastic retainer rings fixing the ball bearing, the removal is completed.
3.2.2 Input Component Removal

1. Remove 4 bolts between the variable speed pump and the oil feed flange.

2. Remove 4 bolts between the variable speed pump and the oil feed flange.
3. Knock the output shaft with the copper rod to knock out the variable speed pump.

4. Take down the variable speed pump, packing and output shaft and remove the bolt between the variable speed pump cover and the variable speed pump shell.

5. Take down the bearing snap ring from the output shaft with the snap ring pliers and remove the ball bearing, piston ring and compensation washer.
6. Knock the output shaft with the copper rod and take down the variable speed pump cover, internal gear and other component.

7. Remove the internal gear of the variable speed pump, output shaft, variable speed pump cover and ball bearing.

8. Take out the external ring gear of the variable speed pump.
9. Take down the safety valve of the oil inlet of the torque converter on the oil feed flange, steel ball and pressure spring.

10. Take down the snap ring fixing the ball bearing on the drive shaft with the snap ring pliers.

11. Knock the drive shaft with the copper rod for removal.
12. Take down the driving gear, ball bearing and roller bearing.

13. Remove the plunger ring from the drive shaft.

3.2.3 KVK1 Clutch Removal

1. Take down the compensation washer and thrust washer of the KVK1 clutch.
1 Compensation washer
2 Thrust washer
3 Thrust washer
4 Thrust washer

2. Take down the roller of the roller bearing on the KV clutch gear.

1 Roller×14

3. Take down the washer of the KV clutch gear roller bearing.

1 Roller bearing washer
4. Take down the roller of the roller bearing on the KV clutch gear.

5. Take down the KV clutch gear and bearing thrust washer.

6. Take down the thrust washer from the KV clutch.
7. Take down the elastic retainer ring fixing the KV clutch bearing plate.

8. Take down the bearing plate of the KV clutch friction lining.

9. Take out the external friction lining of the KV clutch.
10. Take out the internal friction lining of the KV clutch.

Figure 3-96
1 Internal friction lining

11. Take out the external and internal friction linings and place them aside.

Figure 3-97

12. Install the clutch spring removal tooling onto the clutch.

Figure 3-98
1 Clutch spring removal tooling
(29380017591) (29380017601)
13. Screw down the nut on the clutch tooling and press down the clutch spring.

14. Take down retainer ring fixing the pressuring spring of the KV clutch with the snap ring pliers.

15. Take down the retainer ring and the guide ring.
16. Take out the pressure spring and guide ring of the KV clutch.

![Figure 3-102](image1)

1 Lower guide ring  
2 Pressure spring  
3 Upper guide ring

17. Take out the KV clutch piston.

![Figure 3-103](image2)

1 KV clutch piston

18. Remove the needle bearing of the KV clutch.

![Figure 3-104](image3)

1 Check valve  
2 Needle bearing
19. Take down the snap ring fixing the K1 clutch gear bearing with the snap ring pliers and take down the adjustable washer and the bearing component.

20. Take down the gear and thrust washer of the K1 clutch.

21. Take down the elastic retainer ring fixing the K1 clutch bearing plate.
22. Take down the bearing plate of the K1 clutch friction lining.

23. Take out the external friction lining of the K1 clutch.

24. Take out the internal friction lining of the K1 clutch.
25. Take out the external and internal friction linings and place them aside.

26. Install the clutch spring removal tooling onto the clutch.

27. Screw down the nuts on the clutch tooling and press down the clutch spring.
28. Take down the retainer ring fixing the K1 clutch pressure spring with the snap ring pliers.

29. Take out the retainer ring and the guide ring.

30. Take out the pressure spring and guide ring of the K1 clutch.
31. Take out the K1 clutch piston.

32. After removing the K1 clutch needle bearing, the removal is completed.

### 3.2.4 KRK2 Clutch Removal

1. Take down the roller of the KR clutch roller bearing.

![Figure 3-117](image-url)  
1 K1 clutch piston

![Figure 3-118](image-url)  
1 Needle bearing  
2 Check valve

![Figure 3-119](image-url)  
1 KR clutch assembly  
2 K2 clutch assembly
2. Take out 14 rollers in the external layer.

3. Take out the washer of the KR clutch roller bearing.

4. Take out the roller of the KR clutch roller bearing.
5. Remove the KR clutch gear and take out the thrust washer from the bearing.

Figure 3-123
1 KR clutch gear
2 Thrust washer

6. Take out the thrust washer from the KR clutch.

Figure 3-124
1 Thrust washer
2 Thrust washer

7. Take down the elastic retainer ring fixing the KR clutch bearing plate.

Figure 3-125
1 Elastic retainer ring
8. Take out the bearing plate of the KR clutch friction lining.

9. Take out the external friction lining from the KR clutch.

10. Take out the internal friction lining from the KR clutch.
11. Take out the external and internal friction linings and place them aside.

12. Install the clutch spring removal tooling and press down the KR clutch pressure spring.

13. Take down the retainer ring of the KR clutch pressure spring with the snap ring pliers.
14. Take out the retainer ring and guide ring of the KR clutch.

Figure 3-132
1 Guide ring
2 Retainer ring

15. Take out the guide ring and pressure spring of the KR clutch.

Figure 3-133
1 Lower guide ring   2 Pressure spring
3 Upper guide ring

16. Take out the KR clutch piston.

Figure 3-134
1 KR clutch piston
17. Remove the needle bearing on the KR clutch.

18. Take out the roller bearing of the K2 clutch gear.

19. Take down the gear and thrust washer of the K2 clutch.
20. Take out the thrust washer on the KR clutch pressure spring.

Figure 3-138
1 Thrust washer

21. Take down the elastic retainer ring fixing the K2 clutch bearing plate.

Figure 3-139
1 Elastic retainer ring

22. Take out the bearing plate on the K2 clutch friction lining.

Figure 3-140
1 Bearing plate
23. Take out the external friction lining of the K2 clutch.

24. Take out the internal friction lining of the K2 clutch.

25. Take out the external and internal friction linings and place them aside.
26. Take out the K2 clutch piston.

27. After removing the roller bearing of the K2 clutch, the removal is completed.

### 3.2.5 K3K4 Clutch Removal

1. Take down the K4 clutch gear bearing.
2. Place the bearing aside.

3. Take down the lining seal ring component and roller of the needle bearing of the K3 clutch gear.

4. Take down the gear, washer and thrust washer of the K3 clutch.
5. Take down the gear and thrust washer of the K4 clutch.

6. Take down the elastic retainer ring of the K4 clutch.

7. Take out the bearing plate of the K4 clutch.
8. Take out the external and internal friction linings of the K4 clutch.

9. Install the clutch tooling onto the clutch.

10. Screw down the tooling nut and press down the clutch spring.
11. Take down the retainer ring fixing the pressure spring with the snap ring pliers.

12. Take out the retainer ring and the guide ring of the K4 clutch in turn.

13. Take out the upper guide ring, pressure spring and lower guide ring on the K4 clutch in turn.
14. Take out the piston and seal ring of the K4 clutch.

15. The removal of the K4 clutch is completed.

16. Take out the elastic retainer ring of the K3 clutch bearing plate.
17. Take out the K3 clutch bearing plate.

18. Take out the external and internal friction linings of the K3 clutch.

19. Press down the K3 clutch pressure spring with the clutch spring removal tooling.
20. Take down the retainer ring fixing the pressure spring with the snap ring pliers.

21. Take out the retainer ring and guide ring of the K3 clutch in turn.

22. Take out the upper guide ring, pressure spring and lower guide ring of the K3 clutch in turn.
23. Take out the piston and seal ring of the K3 clutch.

Figure 3-168
1 Seal ring  
2 K4 clutch piston  
3 Seal ring

24. Remove the needle bearing and check valve of the K3K4 clutch.

Figure 3-169
1 Check valve  
2 Needle bearing

25. The K4 clutch removal is completed.
4 Transmission Assembly

4.1 Assembling of the Transmission Assembly

4.1.1 K3K4 Clutch Assembly

1. Knock the needle bearing into the clutch bearing hole and install the retainer ring.

★ Attention
Before assembling, clean all parts.

2. Install the seal ring into the piston groove and install the piston component into the clutch cylinder.

★ Attention
When installing the seal ring, the sealing surface of the seal ring shall face towards the pressure oil surface.
3. Place the guide ring and the pressure spring into the clutch cylinder.

4. Place the guide ring and the retainer ring into the clutch cylinder.

5. Install the spring removal and assembling tooling onto the clutch.

Figure 4-4
1 Guide ring  2 Pressure spring
3 Guide ring

Figure 4-5
1 Guide ring
2 Retainer ring

Figure 4-6
1 Clutch spring removal and assembly tooling (29380017591) (29380017601)
6. Screw down the nuts on the tooling and press down the clutch spring.

7. Install the retainer ring into the clutch cylinder clip groove with the snap ring pliers.

8. Take down the clutch spring removal and assembling tooling.
9. Firstly, place the external friction lining into the K3 clutch.

★ **Attention**

During use, if the external friction lining of the clutch is worn out and more than 2/3 parts of the pattern groove of the friction lining are worn out, timely replacement shall be done.

---

10. Place the internal friction lining into the K3 clutch.

★ **Attention**

Firstly, place the external friction lining into the K3 clutch and then place the external and internal friction linings in turn, including 10 external friction linings and 9 internal friction linings.

---

11. Place the bearing plate into the K3 clutch.
12. Install the elastic retainer ring into the K3 clutch.

13. Slightly push the K3 clutch friction lining upwards to the upper limit position with the screwdriver; record the clutch piston stroke which is measured by the dial indicator, and the K3 clutch assembling is completed.

★ Attention

Press the dial indicator contact onto the bearing plate and select different positions for three measurements at the least. The dial indicator reading is the K3 clutch piston stroke. Select the internal friction lining with different thickness to ensure that the piston stroke is 1.8mm~2.2mm.

14. Knock the K4 clutch needle bearing into the clutch bearing hole and install the retainer ring.
15. Install the seal ring into the K4 clutch piston groove.

★ Attention

When installing the seal ring, the sealing surface of the seal ring shall face towards the pressure oil surface. (Refer to Figure 4-3)

16. Install the K4 clutch piston into the clutch.

17. Install the guide ring and the pressure spring into the clutch cylinder.
18. Install the guide ring and the retainer ring.

Figure 4-19
1 Guide ring
2 Retainer ring

19. Install the clutch spring removal and assembling tooling onto the clutch.

Figure 4-20
1 Clutch spring removal and assembling tooling (29380017591) (29380017601)

20. Screw down the nuts on the clutch removal tooling and press down the clutch spring.

Figure 4-21
21. Install the retainer ring into the cylinder clip groove of K4 clutch with the snap ring pliers.

Figure 4-22
1 Retainer ring
2 Snap ring pliers

22. Take down the clutch spring removal and assembling tooling.

Figure 4-23
1 External friction lining

23. Firstly, place the external friction lining into the K4 clutch.

★ Attention
During use, if the external friction lining of the clutch is worn out and more than 2/3 parts of the pattern groove of the friction lining are worn out, timely replacement shall be done.
24. Install the internal friction lining into the K4 clutch.

★ Attention
Firstly, place the external friction lining into the clutch and then place the external and internal friction linings in turn, including 9 external friction linings and 8 internal friction linings.

25. Place the bearing plate into the K4 clutch.

26. Install the elastic retainer ring into the K4 clutch.
27. Slightly push the K4 clutch friction lining upwards with the screwdriver and record the clutch piston stroke which is measured by the dial indicator.

**Attention**
Press the dial indicator contact onto the bearing plate and select different positions for three measurements at the least. The dial indicator reading is the K4 clutch piston stroke. Select the internal friction lining with different thickness to ensure that the piston stroke is stroke: 1.8mm~2.2mm.

28. Install the thrust washer into the K3 clutch gear.

**Attention**
The thrust washer shall be coated with grease.

29. Install the gasket and the thrust washer into the K3 clutch.
30. Install the K3 clutch gear.

★ Attention

Before installing the gear, it is necessary to perform alignment to the internal friction lining splines of the clutch.

31. Install the lining seal ring component and roller of the internal needle bearing of the K3 clutch gear.

★ Attention

The roller shall be coated with grease to prevent the clutch assembly dropping when being installed into the transmission body.

32. Install the thrust washer into the K4 clutch cylinder clip and gear.

★ Attention

The thrust washer shall be coated with grease.
33. Install the needle bearing into the K4 clutch gear.

![Figure 4-34](image)

1 Needle bearing

34. Install the K4 clutch gear.

★ Attention

Before installing the gear, it is necessary to perform alignment to the internal friction lining splines of the clutch.

![Figure 4-35](image)

1 K4 clutch gear

35. The K3K4 clutch assembling is completed.

★ Attention

The KVK1 and KRK2 clutch assembling process can follow the K3K4 clutch assembling process, which is omitted here.

![Figure 4-36](image)

1 K3K4 clutch assembly
36. The KVK1 clutch assembling is completed.

Figure 4-37
1 KVK1 clutch assembly

37. The KRK2 clutch assembling is completed.

Figure 4-38
1 KRK2 clutch assembly

4.1.2 Main PTO Assembly

1. Install the needle bearing into the wheel hub of the output transmission body and then install the retainer ring.

Figure 4-39
1 Retainer ring×2
2 Needle bearing
2. Install the retainer ring into the transmission gear hole and then install the gear into the wheel hub of the output transmission body.

3. Insert the PTO shaft into the gear hole; knock in the ball bearing, and insert 2 elastic retainer rings and 1 retainer ring.

4. The PTO assembling is completed.
4.1.3 Input Part Assembly

1. Knock the ball bearing onto the auxiliary driving shaft.

2. Install the flat key of the internal gear of the gear pump on the shaft and cover it with the oil pump.

3. Knock another ball bearing into the oil pump bearing hole.

★ Attention
Ensure that the auxiliary driving shaft can flexibly rotate.
4. Install the clip for shaft and buckle seal ring.

5. Knock the needle bearing into the bearing hole of the pump impeller bearing seat and then install the oil seal.

★ Attention
Replace the old oil seal with a new one.

6. Install the roller bearing into the bearing hole of the oil feed flange.

★ Attention
Before assembling, it is necessary to clean the oil feed flange.
7. Install the input gear into the oil feed flange and adjust the gear clearance.

8. Install the seal ring onto the drive shaft.

9. Insert the drive shaft and install the ball bearing.
10. Install the elastic retainer ring.

11. Install the adjustable washer into the gear pump hole.

**Attention**

Ensure that the axial run-out clearance of the output shaft bearing is 0.2mm~0.4mm.

12. Install the steel ball and the pressure spring into the safety valve hole of the torque converter on the oil feed flange.
13. Place the oil pump packing on the oil feed flange oil pump surface; coat it with grease, and insert the oil pump component into the oil feed flange component hole.

Figure 4-55
1 Oil pump packing

14. Screw down the bolt between the oil pump component and the oil feed flange component.

\[ \text{Nm} : 23 \text{N.m} \]

15. Place the packing of the pump impeller bearing seat on the oil feed flange surface.

Figure 4-56
1 Hexagon head screw (M8*115)×4
1 Hexagon head screw (M8*85)×4

Figure 4-57
1 Packing
4.2 Transmission Assembly

4.2.1 Output Part Assembly

1. Place the output shaft gear; install the baffle plate and the oil shield into the transmission body, and then fix them with two bolts (M8*16) and the washer.

2. Knock out the roller bearing and place it at the output gear shaft end, and then place it into the oil shield; install the spacer sleeve and insert the output shaft.

16. After knocking in the pump impeller bearing seat and screwing down the bolt between the pump impeller bearing seat and the oil feed flange, the assembling is completed.

\[ \tau_{N_n} : 23 \text{N.m} \]
3. Adjust the washer in turn.

★★ Attention

Select the adjustable washer with different thickness, so as to ensure that the axial clearance of the bearing is 0.1mm~0.3mm.

Figure 4-61
1 Output shaft

4. Install the snap ring.

Figure 4-62
1 Adjustable gasket
2 Snap ring (120*4)

5. Install the oil seal into the transmission body with the tooling.

★★ Attention

Replace the removed oil seal with a new one.

Figure 4-63
1 Oil seal
2 Oil seal assembling tooling
(29380017071)
6. Install the parking brake drum wheel.

⚠️ **Attention**

During installation, take protection measures to avoid tension spring detachment.

7. Install the output flange, O-ring, distance washer and pressure plate in turn.

8. Screw down the bolt between the pressure plate and the output shaft.

\[ \text{Force} (\text{Nm}) : 46 \text{N.m} \]
9. Install the lock washer with the lock washer assembling tooling.

Figure 4-67
1 Lock washer assembling tooling (29380017101)

10. Install the snap ring, bearing, adjustable washer and snap ring at the front end of the output shaft in turn.

★ Attention
Select the adjustable gasket with different thickness, so as to ensure that the axial clearance of the bearing is: 0.1mm~0.3mm.

Figure 4-68
1 Roller bearing
2 Snap ring (120*4)×2

11. Install the oil seal into the transmission body with the tooling.

★ Attention
Replace the removed oil seal with a new one.

Figure 4-69
1 Oil seal
2 Oil seal assembling tooling (29380017071)
12. Install the output flange onto the output shaft.

Figure 4-70
1 Output flange

13. Place the O-ring, distance washer and pressure plate in turn.

Figure 4-71
1 Pressure plate 2 Distance washer (A=0.6)
3 O-ring

14. Screw down the bolt between the pressure plate and the output shaft.

\[ 46 \text{N.m} \]

Figure 4-72
1 Hexagon head screw (M10*30)×2
15. Lock the lock washer with the tooling.

16. Screw down 2 bolts (M10*25) between the butterfly pressure plate and the pressure plate and then install the additional washer and nut.

   \[ \text{Torque: } 68 \text{N.m} \]

17. After installing the bolt and washer between the pressure plate and the output flange, the assembling is completed.

   \[ \text{Torque: } 68 \text{N.m} \]
4.2.2 Intermediate Shaft Component Assembly

1. Install the roller bearing into the bearing hole of the intermediate shaft gear and fix it with grease for standby.

2. Place the intermediate shaft gear component into the gear groove of the transmission body; insert the intermediate shaft and install the gasket.

3. Install the screw and then install the sealing washer.

\[
\text{Nm} : 80\,\text{N.m}
\]
4. The intermediate shaft assembling is completed.

4.2.3 Torque Converter Pressure Control Valve Assembly

1. Install the pressure spring and the valve core into the valve sleeve hole.

2. Firstly, install the O-ring onto the screw plug, and then install the valve sleeve component into the pressure maintaining valve hole of the torque converter of the transmission body and screw down the screw plug; after that, the assembling is completed.

Figure 4-79
1 Sealing washer

Figure 4-80
1 Pressure spring 2 Valve core 3 Valve sleeve

Figure 4-81
1 O-ring 2 Screw plug (CM30*1.5)
4.2.4 Assembling of the K3K4 Clutch Assembly

1. Install the O-ring and piston ring on the K3K4 clutch shaft.

Figure 4-82
1 K3K4 clutch assembly

Figure 4-83
1 Piston ring×3
2 O-ring (49*3)

2. Coat the thrust washer with grease and fix it onto the inner wall of the transmission body.

Figure 4-84
1 Thrust washer
2 Thrust washer
3. Place the clutch assembly into the transmission body.

⚠️ Attention

When placing the clutch, use the tooling and jack up the bottom of the clutch to avoid its falling.

Figure 4-85
1 K3K4 clutch assembly
2 Clutch assembling tooling (29380017611)

Figure 4-86

4. Overturn the transmission to make it be in a horizontal position, and then install the clutch assembling tooling.

Figure 4-87
1 K3K4 clutch assembly
2 Hexagon nut (M8)×2

5. Take out the tooling; install the K4K3 clutch shaft and screw down the nut fixing the clutch assembly.

🌟 Attention

The K3K4 clutch gear can flexibly rotate.

扭力 (Nm) : 23N.m
6. Slowly jack up the clutch assembly with the crowbar to make it have axial runout, and then record the dial indicator reading.

★ Attention

Select the adjustable washer with different thickness, so as to ensure that the axial clearance of the clutch assembly is: 0.1mm~0.3mm; after that, the assembling is completed.

4.2.5 Rotation Speed Sensor Assembly

1. Screw the rotation speed sensor into the mounting hole.

★ Attention

Before screw in, observe the mounting hole and rotate the clutch to align the K3 gear top at the hole center; after that, slowly screw in the sensor to make it contact with the gear top.
2. Screw out the rotation speed sensor by 120°~192° and measure the clearance between the sensor and the transmission body with the feeler gauge.

警告

确保传感器与K3齿轮顶部的距离为0.5mm~0.8mm。

旋转速度传感器规格：M18×1.5。

3. 选择合适的可调节垫圈并将其装配到传感器上，然后拧紧传感器并涂上密封胶；之后，装配完成。

AT262密封胶

4. 2.6 KRK2离合器装配

1. 涂抹离合器装配的推力垫圈的油脂。
2. Place the washers onto the transmission body wall.

3. Install the clutch tooling onto the KRK2 clutch and place it into the transmission body.

⚠️ **Attention**

When placing the clutch, jack up the clutch bottom with the tooling to avoid clutch falling.

4. Take out the clutch shaft installation tooling; install the KRK2 clutch shaft and screw down the nut fixing the KRK2 clutch shaft.

⭐️ **Attention**

The KRK2 clutch gear can flexibly rotate.

$$\text{**Nm**} = 23\text{N.m}$$
5. Slowly jack up the clutch assembly with the crowbar to make it have axial runout; measure and record the axial clearance of the clutch (the measurement method can follow that specified in 4.2.4 K3K4 Clutch Assembling). Select the adjustable washer with different thickness, so as to ensure that axial clearance of the KRK2 clutch shaft is 0.1mm~0.3mm; after that, the assembling is completed.

4.2.7 KVK1 Clutch Assembly

1. Coat the thrust washer of the clutch assembly with grease.

2. Place the washers onto the transmission body wall.

Figure 4-97
1 KRK2 clutch shaft

Figure 4-98
1 KVK1 clutch assembly

Figure 4-99
1 Washer
3. Install the clutch tooling onto the KVK1 clutch and place it into the transmission body.

⚠️ Attention

When placing the clutch, jack up the clutch bottom with the tooling to avoid clutch falling.

---

Figure 4-100

1 Clutch assembling tooling
2 KVK1 clutch assembly

---

4. Take out the clutch shaft installation tooling; install the KVK1 clutch shaft and screw down the nut fixing the KVK1 clutch shaft.

⭐️ Attention

The KVK1 clutch gear can flexibly rotate.

扭力 (Nm) : 23N.m

---

Figure 4-101

1 Hexagon nut (M8)×2

---

5. Slowly jack up the clutch assembly with the crowbar to make it have axial runout; measure and record the axial clearance of the clutch (the measurement method can follow that specified in 4.2.4 K3K4 Clutch Assembling). Select the adjustable washer with different thickness, so as to ensure that axial clearance of the KRK2 clutch shaft is 0.1mm~0.3mm; after that, the assembling is completed.

Figure 4-102

1 KVK1 clutch shaft
4.2.8 Auxiliary PTO Assembly

1. Place the transfer gear into the transmission body.

2. Knock in the PTO shaft to make the retainer ring on the shaft fits with the gear.

3. Install the bearing snap ring on the PTO shaft with the snap ring pliers.
4. Assemble the PTO end cover and install the additional packing.

★ Attention

Replace the removed packing with a new one.

Figure 4-106
1 PTO end cover

5. After screwing down the bolt between the PTO end cover and the transmission body, the assembling is completed.

\[
\begin{align*}
\text{Nm} & : 16N.m
\end{align*}
\]

4.2.9 Input Component Assembly

1. Install the input device onto the transmission body; install the additional packing and knock it in with the copper rod.

★ Attention

Upon installation, screw in two bolt positioning thread holes. Replace the removed packing with a new one.

Figure 4-107
1 Hexagon head screw (M8*16)×8

Figure 4-108
1 Input component
2. Assemble the lubricating oil pipe component and screw down the hollow screw between the oil pipe and the transmission body.

\[
\text{Tightening torque: } 34 \pm 5 \text{N.m}
\]

Figure 4-109

1 PTO lubricating oil pipe component

3. Assemble the connecting shell and knock it in with the copper rod.

★ Attention

Upon assembling, align it at the positioning pin hole. Upon knock in, ensure that the force which is applied on the connecting shell is uniform.

Figure 4-110

1 Torque converter connecting shell

4. After screwing down the bolt between the transmission body, flange and connecting shell, the assembling is completed.

★ Attention

Align at the pin position, and repeatedly screw down the bolt in accordance with the diagonal sequence.

\[
\text{Tightening torque: } 68 \text{N.m}
\]
4.2.10 Main PTO Component Assembly

1. After installing the main PTO component and screwing down the bolt and nut between the PTO and the transmission body, the assembling is completed.

★ Attention

Repeatedly screw down the bolt in accordance with the diagonal sequence.

\[ \text{Nm} \quad : 23\text{N.m} \]

4.2.11 Oil Filter Assembly

1. Install additional O-ring onto the oil filter and screw in the transmission body.

2. Screw down the oil filter with the belt spanner.

Figure 4-112
1 Hexagon head screw×10
2 Hexagonal nut (M8)×1

Figure 4-113
1 O-ring
2 Oil filter

Figure 4-114
4.2.12 Transmission Control Valve Assembly

1. Respectively place the paper pad, lower partition plate, paper pad and oil passage plate onto the transmission body valve plate plane.

★ Attention

Replace the removed paper pad with a new one.

Before assembling, clean the valve plate, oil passage plate and baffle plate of the transmission body.

2. Fix 3 bolts between the oil passage plate and the transmission body.

\[
\text{Nm} : 20 \text{N.m}
\]

3. Fix 8 bolts between the oil passage plate and the transmission body.

\[
\text{Nm} : 20 \text{N.m}
\]

★ Attention

Repeatedly screw down the bolt in accordance with the diagonal sequence.
4. Place the paper pad, upper partition plate, paper pad and control valve onto the oil passage plate.

⭐ Attention

Replace the removed paper pad with a new one.

Before assembling, clean the baffle plate and the variable speed valve.

5. Screw down 11 bolts between the variable speed valve and the transmission body.

\[ \text{N}_\text{m} : 20 \text{N.m} \]

⭐ Attention

Repeatedly screw down the bolt in accordance with the diagonal sequence.

6. Screw down 5 bolts between the variable speed valve and the transmission body.

\[ \text{N}_\text{m} : 20 \text{N.m} \]

⭐ Attention

Repeatedly screw down the bolt in accordance with the diagonal sequence.
7. Screw down 1 bolt between the variable speed valve and the transmission body.
   : 20N.m

8. Install the oil pipe of the variable speed valve.
   : 35±3.5N.m

9. From top to bottom, six oil holes on the oil passage plate are K2, K1, K3, K4, KR and KV oil pipes, which are connected with the oil passage holes on the K1, K2 and K3 shafts.

★ Attention
After adjusting the hose position, screw down the bolt again.
   : 55±5.5N.m
10. The assembling of the transmission control valve and the oil pipe component is completed.

4.2.13 Torque Converter Assembly

1. After installing the intermediate ring and the torque converter into the connecting shell, the assembling is completed.

⚠️ Attention

As there is no axial positioning after installing the torque converter, fixing measures shall be adopted to avoid its falling.

2. The torque converter assembling is completed.
5 Malfunction Diagnosis and Troubleshooting

5.1 Malfunction Diagnosis and Troubleshooting of the Transmission System

1. Vehicle start failure: Table 5-1

<table>
<thead>
<tr>
<th>No.</th>
<th>Malfunction Point</th>
<th>Troubleshooting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if engaging the neutral gear of the gearshift handle</td>
<td>Engage the neutral gear</td>
</tr>
<tr>
<td>2</td>
<td>Check if the EST electric control box and wire plug are loose</td>
<td>Push and press the plug till there is a “click” sound</td>
</tr>
<tr>
<td>3</td>
<td>Check if the battery is fully charged</td>
<td>Charge or replace the battery</td>
</tr>
<tr>
<td>4</td>
<td>Check if the starter circuit has malfunction and if the starter fuse is burnt out</td>
<td>Return the circuit to normal</td>
</tr>
</tbody>
</table>

2. Normal vehicle start but traveling failure: Table 5-2

<table>
<thead>
<tr>
<th>No.</th>
<th>Malfunction Point</th>
<th>Troubleshooting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if the transmission has sufficient oil and check the oil level in case of cold and hot states</td>
<td>Adjust the oil level to normal</td>
</tr>
<tr>
<td>2</td>
<td>Check if the wire plug of the transmission control valve is screwed down</td>
<td>Screw down the plug</td>
</tr>
<tr>
<td>3</td>
<td>Check if the EST electric control box and wire plug are loose</td>
<td>Push and press the plug till there is a “click” sound</td>
</tr>
<tr>
<td>4</td>
<td>Check if the plug connecting with the gearshift selector cable is loose</td>
<td>Firmly insert the plug.</td>
</tr>
<tr>
<td>5</td>
<td>Check if the locking switch of the gearshift selector neutral gear is turned on</td>
<td>Turn on the neutral gear locking switch</td>
</tr>
<tr>
<td>6</td>
<td>Check if the parking brake is released</td>
<td>Loosen the parking brake</td>
</tr>
<tr>
<td>7</td>
<td>Check if the transmission oil pressure on the instrument panel is normal</td>
<td>Check the transmission oil pressure gauge</td>
</tr>
<tr>
<td>8</td>
<td>Check if the ventilating valve on the transmission is blocked and if oil flows out</td>
<td>Clean the ventilating valve and check if the oil quantity is proper.</td>
</tr>
<tr>
<td>9</td>
<td>Check if the speed sensor plug is loose and if the speed sensor cable wire is worn out.</td>
<td>Screw down the plug and wrap up or replace the worn-out cable wire.</td>
</tr>
</tbody>
</table>
3. Functions of the parts and common malfunction troubleshooting

(1) Electric control box

After turning on the electric lock switch and turning the gearshift handle to the neutral gear, the electric control box is in a ready state. To shift the gear after the vehicle start, rotate the gearshift handle to select certain gear, and the electric control box can, based on the electric signal from the output speed sensor and the gearshift handle, automatically judge if it can turn to the preselected gear at the current speed. If these two have too large speed difference, the computer can command the solenoid valve to engage the transmission with certain applicable min. speed gear and then turn to the preselected speed gear at an interval of 2.5s. For example, if engaging the third gear from the first gear, the computer will identify the speed signal of the speed sensor and judge if the speed is qualified after receiving the electric signal from the gearshift handle; if the speed is unqualified, it will automatically send the electric signal to the solenoid valve and turn to the second gear firstly; after the speed reaches 14km/h, it will turn to the third gear to mitigate impact.

Common malfunction example:

In case of the loader maintenance, clean it with water; after that, it is found out that the vehicle is unavailable for gear shift and can’t be started. After check, it is found out that the electric control system of the vehicle has normal circuit connection, which is free from mechanical malfunction. The cause is that the electric control box is affected with damp during cleaning; after being dried, the complete vehicle has a normal traveling. Accordingly, during the vehicle cleaning and maintenance, it is necessary to pay attention to the waterproof protection of the computer box and the handle.

The vehicle has normal traveling originally; however after parking for oil filling, it is found out that the vehicle engine can be started while the vehicle can’t be driven. After check, it is found out that both the electric control system circuit and the transmission oil pressure are normal. Later, it is found out that the lower plug of the electric control box is improperly inserted. The cause is that there is a clip fixing the electric control box plug on the electric control box, when there is one “click” sound after inserting both ends of the wire plug into the pin, it means that the clip has firmly fixed the plug; or else, vibration arising from vehicle traveling will loosen the plug.
1 Electric control box of the transmission
2 Cable plug
3 Clip

(1) Electric control box of the 4WG200 transmission

The vehicle structural part has malfunction; after welding the vehicle structural parts, it is found out that the vehicle can’t be started. After check, it is found out that the electric control box is burnt out.

After starting the vehicle, turn off the electric lock. Several minutes later, the counter on the instrument panel smokes and the vehicle can’t be driven. After check, it is found out the cause is violation to the operation regulations: The electric lock is turned off when the engine doesn’t stop. In such case, the generator can’t charge the storage battery and sometimes it will produce higher surge voltage, which will result in dozens of amperes transient current and electric control box damage. However, if connecting the generator with the storage battery circuit, it will stabilize the circuit voltage. Accordingly, it is necessary to turn off the electric lock after the engine stops.

(2) Output speed sensor

The output speed sensor is used to record the rotation frequency of the output gear, so as to help the computer compare the preselected speed with the current speed and make the gearshift decision. The resistance value of the output speed sensor is 1020±100; if the resistance value is 0 or ∞, it means that the sensor has short circuit or open circuit, which shall be replaced.

Common malfunction example:

The vehicle has the first and second gears, while no third and fourth gears. Check steps: After turning off the electric lock, screw off the output speed sensor plug and check it with the universal meter. If the resistance value is 0, it means the speed sensor is damaged.

The complete vehicle is unavailable for any gearshift. After check, it is found out that the oil level is normal and the cable wire between the electric control box and the speed sensor is worn out by metal; after re-wrapping, the vehicle returns to normal.

(3) Gearshift handle

Its inside mainly has two inching switches; by forwards and backwards pulling the handle and rotating the handle sleeve, the direction and speed can be selected.

Common malfunction example:

The user reflects that the loader can’t be accelerated to the fourth gear. After check, it is found out that the transmission oil level is normal but the 8# wire of the 12-hole plug connecting with the gearshift handle is loose, and the cause is that the 8# wire has poor contact. When engaging the fourth gear, the computer can only receive the electric signal from the third gear; accordingly, the loader is unavailable for the fourth gear.

(4) Other typical malfunction

After the transmission oil replacement, the vehicle can’t be driven after about 20m traveling;
after stop and restart, it can only be driven for 10~20m. After check, it is found out that the electric control system has normal circuit, which is free from mechanical malfunction. And the cause is that, the oil level is not checked as specified after oil replacement, which is seriously insufficient. After filling oil till reaching the normal oil level, the vehicle can be normally driven.

5.2 Malfunction Diagnosis and Troubleshooting of Transmission

1. Cause of the gearshift clutch malfunction

The transmission clutch is a kind of vulnerable part. When engaging the transmission clutch, the hydraulic pressure will pass through the piston; overcome the spring force and press down the friction lining. The friction lining will contact with the metal plate and both of them will be pressed down along with the hydraulic pressure increase.

In case of each gearshift, friction will occur between the friction lining and the steel sheet. Though the friction heat quantity arising from the coolant has been considered in design, the cooling effect is limited. When becoming thinner, the clutch will need more hydraulic oil to bring full engagement between the friction lining and the steel sheet; in such case, the diesel engine shall be further accelerated.

When accelerating the engine to very high idle speed, the friction lining slipping time on the steel sheet will be extended accordingly and the friction heat quantity will be larger as well. When the increase of the hydraulic oil heating time and temperature can change the sealing characteristics of the transmission, there will be internal leakage in the transmission. And, the internal leakage will increase the heat quantity from two aspects:

When the high pressure oil passes through the damaged seal, it will leak and result in friction, thus the oil temperature will continue rising;

As the oil leakage will reduce the oil flow in the system; to fully engage the clutch, the hydraulic pump shall convey much more oil to produce necessary oil pressure, namely, the engine shall be further accelerated to make the oil delivery pump output larger flow. Such vicious circulation will finally result in too hot or damaged clutch and even clutch failure.

2. Common malfunction diagnosis and troubleshooting method of the transmission and its oil circuit system

(1) Gear engagement failure

Malfunction cause: Incorrect gearshift position; oil leakage of the clutch piston; low transmission pressure; blocked oil circuit in the transmission body.

Troubleshooting method: Engage the gear again or check the transmission control valve; remove, check and replace the rectangular ring. The details of the troubleshooting method of the low transmission pressure are shown in (2) Removal, cleaning and dredging.

(2) Low transmission pressure

Malfunction cause: Improper adjustment of the main pressure regulating valve; broken spring and spring failure; low transmission oil level; blocked filter screen or oil passage; oil leakage of the clutch; variable speed oil pump failure.
Troubleshooting method: Re-adjust or replace the spring; fill oil till reaching the specified oil level; clean or dredge it; replace the rectangular ring; do inspection or replacement.

(3) Too high oil temperature

Malfunction cause: Too long operation time; insufficient or excessive oil in the transmission; clutch facing slipping; clutch release failure.

Troubleshooting method: Stop or idly run the vehicle for a certain period; fill oil till reaching the overflow hole; check the oil pressure and seal ring; check the position of the clutch control oil circuit or control lever.

(4) Low transmission oil pressure of certain gear

Malfunction cause: Damaged rectangular ring of the piston; damaged oil circuit seal ring; oil leakage or blockage of the oil passage.

Troubleshooting method: Replace the rectangular ring of the piston; replace the seal ring; do check and troubleshooting.

(5) Disordered gear

Malfunction cause: Leakage of the shaft end seal ring.

Troubleshooting method: Replace the seal ring.

(6) System oil leakage

Malfunction cause: Loose connector; damaged seal ring.

Troubleshooting method: Screw down the connector; replace the seal ring.

(7) Automatic oil level rise of the transmission oil pan

The cause is that the input shaft oil seal of the steering pump or the working pump is damaged; the oil of the hydraulic system flows to the transmission oil pan via the torque converter gear case and increases the oil level. The old oil seal can be replaced with a new one according to the damage conditions.